ESA-030-3_Final Public Report

Company	Chrysler	**ESA Dates**	Mar 25-27, 2008
Plant	Indiana Transmission Plant 1	**ESA Type**	Compressed Air
Product	Automotive transmissions	**ESA Specialist**	B. Gopalakrishnan, Ph.D., P.E., C.E.M.

Brief Narrative Summary Report for the Energy Savings Assessment:

Introduction: A three-day energy savings assessment (ESA) was performed at Chrysler Indiana Transmission Plant 1 in Kokomo, IN. The primary business of this company is the production of automotive transmissions. The company has five 1,250-hp centrifugal air compressors (Table 1) and usually four of the five compressors work to meet the plant's compressed air demand. The annual energy consumption by the compressors was estimated as 25,348,220 kWh (using profile data in AIRMaster+). The compressed air system was analyzed during this assessment and the potential annual savings in the electrical energy cost was estimated as 26% with respect to annual energy cost to run the compressors. The potential energy and cost savings are 7,163,422 kWh/yr (equivalent to 24,449 MMBtu/yr) and $325,776/yr respectively.

Objective of ESA: Improve compressed air system efficiency and reduce the operating cost for the company.

Focus of Assessment: Compressed air system.

Approach for ESA: Apply technical expertise and DOE BestPractices software tool AIRMaster+.

General Observations of Potential Opportunities:

Impact electrical cost is $0.02484/kWh and $14.51/kW

Energy Saving Assessment Results
Chrysler - Indiana Transmission Plant 1, Kokomo, IN 46904
Mar 25-27, 2008

This assessment consists of the application of AIRMaster+ developed by the US Department of Energy (USDOE), Industrial Technologies Program. The assessment consisted of training the plant personnel on the use of AIRMaster+ and the utilization of electrical and pressure data loggers for monitoring over an extended period of time. An ultrasonic air leak detector was used to identify compressed air leaks and a handheld pressure gage and power meter were used to obtain instantaneous pressure and power readings respectively. The historical power (kW) and flow (cfm) readings were obtained through BayView control system present in the company and by observing the compressors' control panels during the assessment. The 3-day assessment resulted in the following energy efficiency measures.

Recommendation 1: Use Automatic Sequencer

This recommendation is based on the analysis of the compressors' power consumption and the amount of compressed air (acfm) generated on a typical production day (Figure 1 and Figure 2). Currently, the plant has five centrifugal compressors and usually four of them work at any given time (the AIRMaster+ model is developed with the sequence as #5, #1, #3, #4, and #2 which was based on the data between 3/10/08 and 3/17/08). It was observed that the plant has three operating day types (production or weekdays, Saturdays, and non-production or holidays) and the compressors were blowing off considerable amount of compressed air (Table 2). Based on the operating characteristics of the plant, it is recommended to install an automatic sequencer with the target pressure as 98±3 psig and use the sequence as #2, #1, #4, #5, and #3. The proposed sequence is based on maximizing the cfm to kW ratio (Table 3). After the automatic sequencer is installed, it is expected that only the required compressors will operate and the others will be turned off because of the automatic shutdown timers. This will minimize the unnecessary blow-offs and result in higher system efficiency. The energy, electrical demand, and cost savings from this recommendation are estimated as 4,160,672 kWh/yr (or 14,200 MMBtu/yr), 67 kW/month, and $115,012/yr respectively. To the best of the specialist's knowledge, the implementation cost is estimated as $50,000 with a simple payback of 0.4 years. It is highly likely that the implementation cost will be lower as the new sequence and the set-point can be incorporated in the existing BayView control system. The company is encouraged to make efforts to obtain more accurate implementation costs.

Recommendation 2: Reduce System Air Pressure

Pressure loggers were installed in "68 RFE", "5800 Aluminum drag conveyor", "Compressor room", "5600 CCS 23", "Assembly ATF Dehydrator", and "5400 CLS 38" areas. The compressed air pressure profile in the facility is shown in Figure 3. As seen from the pressure profile, the compressed air pressure fluctuates between 84 psig and 94 psig. Based on the analysis of the pressure profile, it is recommended to install secondary storage tank(s) before major compressed air consumer(s) (e.g. near "5600 CCS 23" and "Assembly ATF Dehydrator") to reduce the pressure fluctuations which will help to reduce the overall system pressure settings. The benefits from this recommendation will be realized after replacing the regular nozzles with vortex nozzles and modifying the end users (Recommendation 4), and repairing the air leaks (Recommendation 3). Based on the expert's conservative estimates, it was estimated that the system pressure can be reduced by at least 5 psig. The energy, electrical demand, and cost savings from this recommendation are estimated as 1,803,328 kWh/yr (or 6,155 MMBtu/yr), 155 kW/month, and $71,809/yr respectively. To the best of the specialist's knowledge, the implementation cost is estimated as $5,000 with a simple payback of 0.1 years. The company is encouraged to make efforts to obtain more accurate implementation costs.

Recommendation 3: Repair Air Leaks

A comprehensive study was performed to find compressed air leaks in the facility. An ultrasonic compressed air leak detector was used to identify the location of air leaks and quantify the energy and cost savings. The sample list of air leaks and the corresponding compressed air lost from the system are provided in Table 4. It was noted that the facility had an ongoing leak detection and repair program. It is recommended to continue the existing program to locate and repair air leaks at frequent intervals (e.g. every month). Based on the sample study, it is estimated that 5% of the generated compressed air is lost because of the leaks. It is assumed that 50% of the leaks can be repaired with an ongoing leak management program. The energy, electrical demand, and cost savings from this recommendation is estimated as 505,254 kWh/yr (or 1,724 MMBtu/yr), 589 kW/month, and $115,100/yr respectively. To the best of the specialist's knowledge, the implementation cost is estimated as $25,000 (includes the engineering planning, material and labor cost only as the company has an ultrasonic leak detector) with a simple payback of 0.2 years. The company is encouraged to make efforts to obtain more accurate implementation costs.

Recommendation 4: Improve End Use Efficiency

The major compressed air users in the plant are shot blast machines, gage tables, dust collectors, machine actuators, and several blow-off nozzles. The facility has several nozzles in these areas that are used for 10-15 minutes each day. It was noted that these nozzles do not have the vortex design and hence use significant amount of compressed air. It is recommended to use vortex nozzles instead of regular nozzles wherever possible. Vortex nozzles reduce the compressed air demand to as low as 1/10th of the current compressed air demand. It is expected that the installation of vortex nozzles will not only reduce the requirement but will help the compressors to operate at almost constant level for longer time and hence increasing the life of the compressors. It was estimated that by improving the end use efficiency, the compressed air requirement can be reduced by 700 cfm during production days, 500 cfm during Saturdays and 300 cfm during Sundays/Holidays. The energy, electrical demand, and cost savings from this recommendation are estimated as 694,168 kWh/yr (or 2,369 MMBtu/yr), 38 kW/month, and $23,854/yr respectively. To the best of the specialist's knowledge, the implementation cost is estimated as $20,000 with a simple payback of 0.8 years. The company is encouraged to make efforts to obtain more accurate implementation costs.

Conclusion

The implementation of Recommendations 1 through 4 for the plant air system is likely to save approximately 800-hp of used compressor capacity for a production day operation. The proposed hourly power consumption is shown in Figure 4 and the savings during different day types are shown in Figures 5 through 7.

Appendix: Table and Figures

Table 1: Compressor Inventory

Compressor Unit	HP	Type	System
IR-compressor #1	1,250	Centrifugal	Plant Air
IR-compressor #2	1,250	Centrifugal	Plant Air
IR-compressor #3	1,250	Centrifugal	Plant Air
TA-compressor #4	1,250	Centrifugal	Plant Air
TA-compressor #5	1,250	Centrifugal	Plant Air

Table 2: Blow-off History of the Compressors

Compressor:	#1	#2	#3	#4	#5
% time with blow-offs	11.8	17.9	33.5	57.8	0
% time at maximum load	38.4	20.1	6.7	0.2	72.4

Table 3: Basis for Proposed Sequence for the Compressors

Compressor #	#1	#2	#3	#4	#5
cfm	5,344	5,443	5,124	4,696	5,261
Power (kW)	998	989	992	890	1,014
cfm/kW	5.35	5.50	5.17	5.28	5.19
Proposed sequence	2	1	5	3	4

Table 4: Location of Compressed Air Leaks with Corresponding Air Loss (as per Ultrasonic Leak Detector Measurements)

Location	No. of Leaks	Estimated acfm loss
ASI Conveyor	1	14.98
ASI Pick-N-Place	1	14.98
Diaphragm Pit Pump	1	33.25
Engr Abrasives	2	29.96
Fuji	5	129.71
Hurricane	1	14.98
Krueger	3	44.94
Moore	2	66.50
SU Samputensil	1	14.98

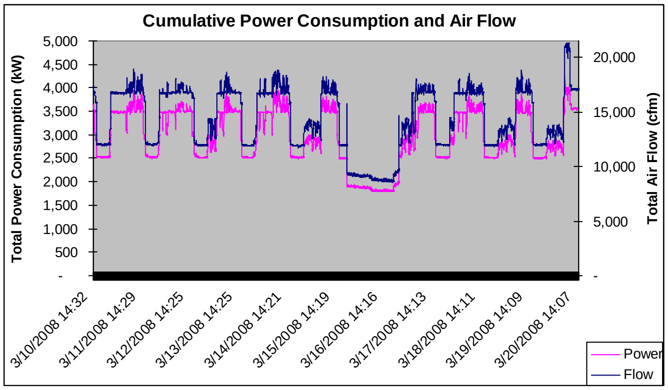

Figure 1: Profile of Total Power Consumption (kW) and Generated Compressed Air (cfm)

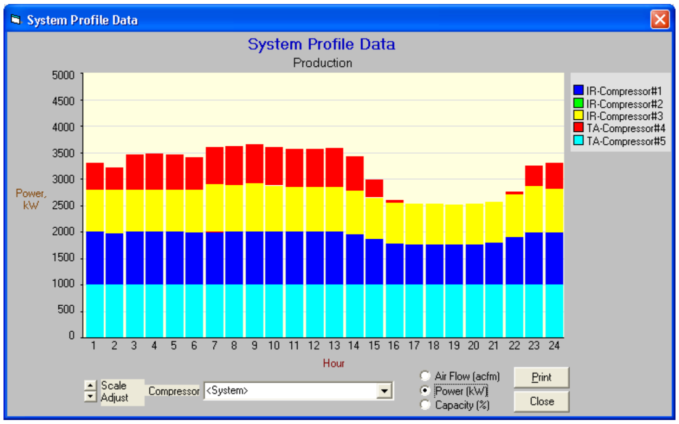

Figure 2: Profile of Compressors' Hourly Power before Improvements (Production Days)

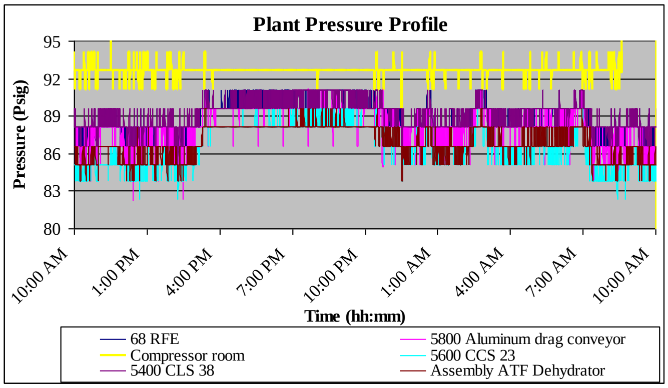

Figure 3: Pressure Profile for the Plant Air System

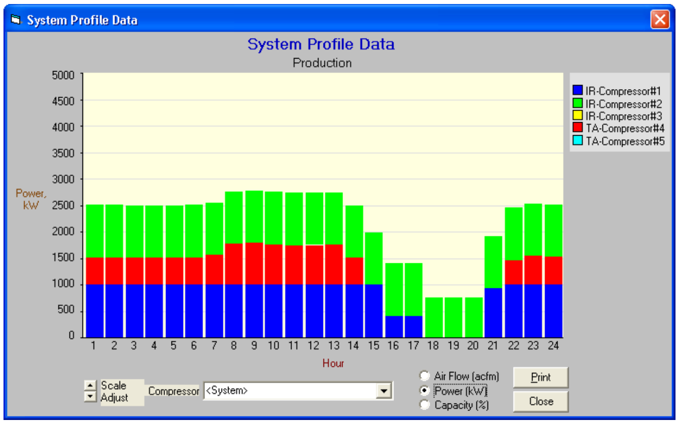

Figure 4: Profile of Compressors' Hourly Power after Improvements (Production Days)

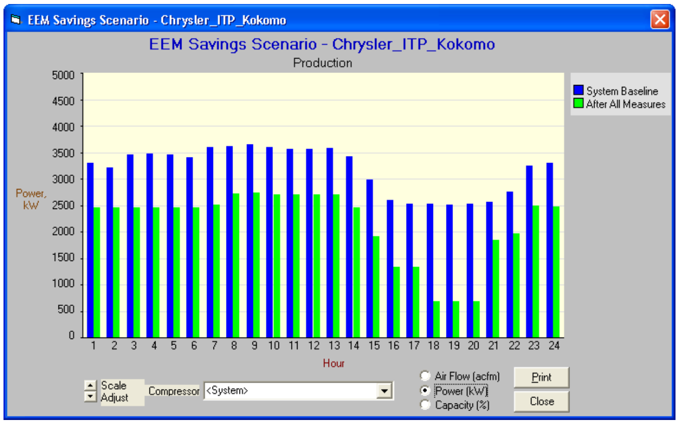

Figure 5: Hourly Profile for Power Savings during Regular Production Days

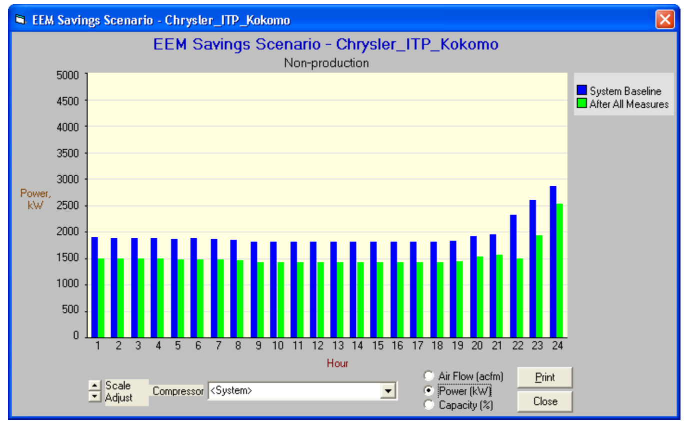

Figure 7: Hourly Profile for Power Savings during Non-Production days

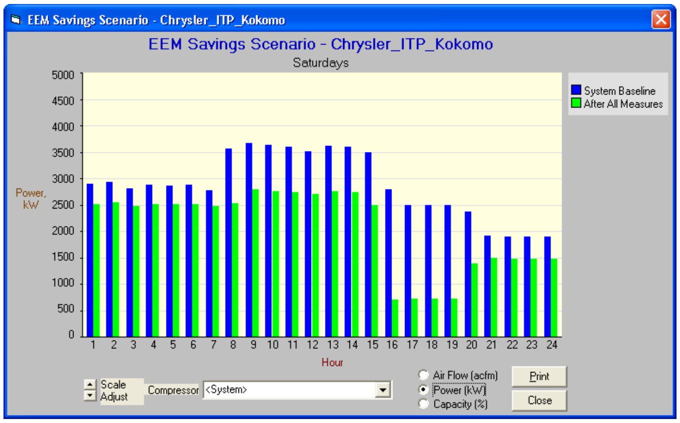

Figure 6: Hourly Profile for Power Savings during Saturdays

Management Support and Comments:

The management at the facility was very supportive and facilitated the productive completion of the assessment. The plant personnel were trained in the use of the AirMaster+ tool. The plant's contact person, Mr. Brian Klemmensen was in agreement with the preliminary findings outlined in this report. The individual comments are summarized in the "Consensus Evaluation" file.

Disclaimer

The purpose of the energy assessment conducted by Pro-Plus Engineering, PLLC on contract with the US Department of Energy is to identify and quantify savings opportunities using prevailing engineering principles. While the preliminary recommendations in this report have been reviewed for technical accuracy, they are based on observed conditions and information obtained during the assessment. Actual savings will depend on many factors, including measures implemented, operating procedures and variations in fuel prices and weather. This report is not intended to provide detailed engineering plans or designs. Pro-Plus Engineering, PLLC does not make any warranty with respect to the accuracy, usefulness or completeness of the savings estimates or the contents of this report. For this reason, your organization is encouraged to carefully evaluate each opportunity and attain further engineering analysis, if desired, to verify or refine any savings estimates.

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